**Understanding the Impact of Environmental Contaminants on Aquatic Organisms: A Multidisciplinary Study**

Emergent pollutants namely pesticides, pharmaceuticals, nanoparticles can reach the aquatic environment through runoff and wastewater discharge and continue to circulate in nanomolar concentrations, causing serious ecological risks for wildlife and contributing to declining biodiversity. Therefore, it is critical to look behind the scenes into the core chemical and biological processes and understand whether and how the use of emergent pollutants may affect non-target wildlife. We propose a new approach for optimizing biomarker-based toxicity assessment based on adverse outcome pathways, which associate molecular initial events with outcomes at higher levels of biological organization. The processes by which pesticides and nanoparticles are accumulated and bioconcentrated in aquatic animals, as well as the toxic mechanisms involved, including biological redox activity, immunotoxicity, neuro-endocrine disorders, and cytotoxicity, which is manifested in oxidative stress, lysosomal and mitochondrial damage, inflammation, and apoptosis/autophagy will be discussed. Hence, the xenobiotic-related multidimensional harm to wildlife should be thoroughly investigated in line with environmental protection policies before it is too late.